Swayam Chube

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This is a list of Mathematics and relevant Computer Science courses I have taken throughout my stay at IIT Bombay. Grades obtained are mentioned alongside the course name.

Mathematics

AA MA403: Real Analysis *Instructor: Prof. Santanu Dey*
Textbook: Mathematical Analysis by Tom Apostol
Metric spaces and their topological properties. Sequences and series, convergence theorems. Derivatives, integration. Fourier series, types of convergence.

AA MA406: General Topology *Instructor: Prof. Sandip Singh*
Textbook: Topology by Munkres
Chapters I through V of the aforementioned book. Ending with a proof of Tychonoff's Theorem.

AA MA408: Measure Theory *Instructor: Prof. Santanu Dey*
Textbook: Real Analysis by Royden and Fitzpatrick
Outer measures, Lebesgue measure on $\mathbb{R}$. Measurable functions. Integration of measurable functions on $\mathbb{R}$. Abstract measure spaces, Fubini and Tonelli's theorems.

AP MA410: Multivariable Calculus *Instructor: Prof. Preeti Raman*
Textbook: Calculus on Manifolds by Spivak
Chapters I through IV of the above book.

AP MA412: Complex Analysis *Instructor: Prof. Shripad Garge*
Textbook: Functions of One Complex Variable by Conway
Chapters I through IV of the above book.

AP MA417: Ordinary Differential Equations *Instructor: Prof. Saikat Mazumdar*
Textbook: Ordinary Differential Equations and Dynamical Systems by Teschl
Chapters I, II, III, and V of the above book.

AA MA419: Basic Algebra *Instructor: Prof. Saurav Bhaumik*
Textbook: Abstract Algebra by Dummit and Foote; Algebra by Lang
Groups, Sylow subgroups, solvable groups, nilpotent groups. Rings, domains, UFDs, PIDs, irreducibility, Gauss' Lemma.

AA MA503: Functional Analysis *Instructor: Prof. Chandan Biswas*
Textbook: Functional Analysis by Rudin
Topological Vector Spaces, Completeness Arguments such as the Uniform Boundedness Principle, Open Mapping Theorem, and Closed Graph Theorem. Weak and Weak* Topologies, Banach-Alaoglu Theorem. Compact Operators.

Mathematics (continued)

AP MA515: Partial Differential Equations *Instructor: Prof. Harsha Hutridurga*
Textbook: No official textbook. A suggested reference was "Partial Differential Equations: Classical Theory with a Modern Touch" by Nandakumaran and Datti
Laplace equation, harmonic functions, various theorems for harmonic functions such as Liouville and Harnack. Heat equation, Li-Yau inequality, Harnack's inequality. Wave equation, Poisson-Kirchhoff representation formula. First order PDEs, characteristic curves, Duhamel's principle. Functional inequalities.

AA MA521: Theory of Analytic Functions *Instructor: Prof. Shripad Garge*
Textbook: Functions of One Complex Variable by Conway
Chapters V through VII of the above book. Classification of singularities, Carorati-Weierstrass. Compact open topologies, spaces of harmonic and meromorphic functions. Marty's theorem, Weierstrass factorization theorem. Gamma and Zeta function.

AA MA523: Basic Number Theory *Instructor: Prof. Ronnie Sebastian*
Textbook: A concise introduction to the theory of numbers by Alan Baker
Modular arithmetic, quadratic residues, quadratic reciprocity. Binary quadratic forms. Continued fractions.

AA MA526: Commutative Algebra *Instructor: Prof. Jugal Verma*
Textbook: Commutative Ring Theory by Matsumura; Cohen-Macaulay Rings by Bruns and Herzog
Noetherian and Artinian rings. Associated primes and length of modules. Primary decomposition in modules. Dimension Theory of modules. Depth and Cohen-Macaulay rings and modules.

AA MA5106: Introduction to Fourier Analysis *Instructor: Prof. Saikat Mazumdar*
Textbook: Fourier Analysis: An Introduction by Shakarchi and Stein
Fourier series, forms of convergence. Fourier transforms, inversion thereof, Plancherel's theorem. Distributions and applications to PDEs.

AA MA5110: Non-commutative Algebra *Instructor: Prof. Shripad Garge*
Textbook: Associative Algebras by Pierce
Basic theory of non-commutative rings. Central simple algebras and the Brauer group. Valuations on division algebras. Local fields and the Brauer group of a local field.

AA MA811: Algebra I *Instructor: Prof. Jugal Verma*
Textbook: Algebra by Serge Lang; Field and Galois Theory by Patrick Morandi
Normal, separable, Galois extensions. Purely inseparable extensions. Abelian, cyclic extensions. Hilbert theorem 90 (additive and multiplicative) and its interpretation as Galois cohomology. Solvable extensions and the insolvability of the quintic. Transcendental extensions, separably generated, linearly disjoint extensions. Basic algebraic geometry using affine varieties and their dimension theory.

Mathematics (continued)

AA MA812: Algebra II *Instructor: Prof. Ronnie Sebastian*
Textbook: Introduction to Commutative Algebra by Atiyah and MacDonald; Algebra by Serge Lang
Chapters IV through X of Atiyah and MacDonald. Non-commutative rings, semisimple rings, the Artin-Wedderburn Theorem. Representation theory of finite groups. Basic homological algebra.

AA MA813: Measure Theory *Instructor: Prof. Dipendra Prasad*
Textbook: Real and Complex Analysis by Rudin
Chapters I through IX of the above book.

AA MA815: Differential Topology *Instructor: Prof. Manoj Keshari*
Textbook: Differential Forms in Algebraic Topology by Bott and Tu
Chapter I of Bott and Tu.

AA MA841: Topics in Algebra I *Instructor: Prof. Shripad Garge*
Textbook: Introduction to Lie Algebras and Representation Theory by Humphreys
Chapters I, II, III, parts of IV, V, and VI of the above book. In particular, solvable, nilpotent Lie algebras. Semisimple Lie algebras, root space decomposition. Root systems, Dynkin diagrams and their classification. Universal Enveloping Algebras and PBW. Abstract theory of weights.

N/A MA824: Functional Analysis *Instructor: Prof. Santanu Dey*

N/A MA848: Topics in Geometry I *Instructor: Prof. Sudarshan Gurjar*
Hartshorne's book. Chapter II and some parts of Chapter III.

N/A MA842: Topics in Algebra II *Instructor: Prof. Ananthanarayan Hariharan*
Will focus on injective resolutions and Gorenstein rings after setting up the required homological algebra.

Computer Science (relevant courses only)

AA CS207: Discrete Structures *Instructor: Prof. Manoj Prabhakaran*

AB CS213: Data Structures and Algorithms *Instructor: Prof. Manoj Prabhakaran*

AA CS228: Logic for Computer Science *Instructors: Prof. Krishna S. and Prof. Ashutosh Gupta*

AA CS218: Design and Analysis of Algorithms *Instructor: Prof. Mrinal Kumar*

AA CS310: Automata Theory *Instructor: Prof. G. Sivakumar*

AA CS779: Extremal Combinatorics *Instructor: Prof. Sunder Vishwanathan*

Computer Science (relevant courses only) (continued)

AB CS786: Randomized Algorithms *Instructor: Prof. Akash Kumar*

BB CS788: Algebraic Automata Theory *Instructor: Prof. Bharat Adsul*

The following are the grade conversions to a 10-point scale.

$$AP = AA = 10,\ AB = 9,\ BB = 8, BC = 7,\ CC = 6,\ CD = 5,\ DD = 4.$$